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ABSTRACT

The safety education unit is presented to assist apprentices to acquire a general knowledge of procedures for insuring safety on the job. The unit consists of 10 modules: (1) the Occupational Safety and Health Act: safety and health bill of rights for workers; (2) accident prevention; (3) first aid; (4) accident reports; importance, use, and how to write one; (5) environment control and hazardous materials (Part 1910: Occupational Safety and Health Standards); (6) fires: how to prevent, control, and minimize losses; (7) personal protective equipment: how and when to use it; (8) ladders and scaffolds: types, use and maintenance; (9) materials handling: lifting, carrying, and placing materials; and (10) ropes, knots, chains, and slings. Each module contains information on the following areas: objectives, references (textbooks and other resources), content, instructional suggestions, and detailed background information. (EC)

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SAFETY

UNIT 8

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FOREWORD

Apprentice training is a systematic way of providing the skilled workers necessary to supply current and future employment demands. Related instruction is an integral part of a planned apprentice training program — ranking in importance with the skills learned on the job. The related instruction provided to apprentices helps them better understand the trade and to know *why* things are done as well as *how* they are done.

A *Core Curriculum of Related Instruction for Apprentices* was designed to provide relevant instruction to apprentices preparing for a variety of trades. It includes the general topics appropriate to all who will be taking their place in the national workforce. Therefore, presentation of related instruction to a mixed group of apprentices becomes a feasible and manageable activity which helps fulfill the legal requirement for this component of a full apprentice program. It leaves the trade-specific information to be provided as the need arises.

The core curriculum is developed in major units or general topics. Modules within each unit are designed as self-contained instructional packages which can be selected for presentation to meet individual and program needs. The objectives of each module are expressed in terms of expected terminal performances which each apprentice should exhibit as a result of instruction. This allows any apprentice who is able to accomplish the student objectives to move on to another module. The program provides sufficient flexibility for the development of instruction to meet the specific needs of a variety of apprentices with differing backgrounds and expectations.

This unit, *Safety*, is one of nine units that have been developed to provide the apprentice with a working knowledge of the various procedures one needs to follow to insure safety on the job. The Administrative Considerations and Instructional Considerations which will be helpful to administrators and journeymen/instructors in developing and conducting an approvable course in related instruction are contained in Unit I, Introduction to Apprenticeship. It is suggested that reference to that unit be made by all who will instruct this unit.

Content relating to the core curriculum was developed under grant at the New York State School of Industrial and Labor Relations, Cornell University, Ithaca, under the supervision of Professor Felician F. Foltman. Assistance relating to content was provided by Charles A. Stebbins, Associate in the Bureau of Trade and Technical Education, with the concurrence of Carl G. Benenati, Chief, who is responsible for the approval and conduct of related instruction programs for apprentices. The material developed was adapted to a curricular format and prepared for publication by Nelson S. Maurer, Associate in the Bureau of Occupational and Career Curriculum.

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UNIT 8 MODULE 1

THE OCCUPATIONAL SAFETY AND HEALTH ACT: SAFETY AND HEALTH BILL OF RIGHTS FOR WORKERS

Explains what the act covers, how it works, and how workers can use it to their advantage

OBJECTIVES

At the completion of this module students will be able to:

1 *Explain why OSHA became a national law in 1970*

2 *Summarize the act's major provisions, requirements, and concepts*

3 *Explain what OSHA means to workers or their representatives and to state their rights and obligations*

4 *Identify the duties of employers*

5 *Relate the important results and consequences of the law*

REFERENCES

(A) Bureau of National Affairs. *The job safety and health act of 1970.* Washington, D.C. The Bureau. 1971.

(B) U.S. Department of Labor. *All about OSHA.* Washington, D.C. U.S. Government Printing Office. 1973.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Reasons for OSHA (1)	Discuss with students why OSHA was considered necessary. (Ref. A; Ref. B)	In recent years around 14,000 workers annually have been killed at their place of work. Also, around 90,000 workers annually have been permanently disabled as a result of accidents at work, and around another 2.2 million workers were injured although not disabled.
• National Industrial Health and Accident Record (1)	*Additional materials on OSHA that may be adapted for class use may be found in the February, 1975 issue of School Shop.*	It has been estimated that if we counted nondisabling, serious accidents (where workers lost less than one day of work) it would total 25 million accidents per year.
		It has been estimated that as many as 100,000 workers die each year due to some occupationally related health hazard such as, asbestos, lead, silica, carbon monoxide, or cotton dust.
• Serious Accidents in Coal Mining (1)		In 1969 Congress passed a law to develop and enforce safety and health standards in the coal mining industry. The immediate pressure for passage of this law came from a mining catastrophe that killed 78 men in the late 60's, plus the fact that the miner's "black lung" disease was becoming more prevalent.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
• Trade Unions Pressure (1)		Congress and the American public were becoming more aware of the safety and health hazards in industry. American trade unions played a prominent part in getting bills before Congress and in obtaining passage of OSHA (PL.91-596 or Williams-Steiger Act after its two Congressional authors).
Provisions, Requirements, and Concepts of the Act (2) • Public Policy (2) • Basic Concepts (2)	Ask students who have actually participated in a safety inspection to recall and indicate what the inspector said and pointed out while making his inspection. Also, determine if the inspector asked any questions about first aid and if he appeared to be looking for particular things.	In the words of the act, its purpose is "to assure safe and healthful working conditions for working men and women." The law establishes a policy that protection of health and safety of workers is a responsibility of the federal government.
• Implementing the Law (2)	Invite a Safety Director from a local firm to discuss OSHA from his perspective.	OSHA is a labor standards act, something like the Fair Labor Standards Act. The assumption is made that the development and publishing of safety and health standards is useful, especially since the act provides for enforcement machinery as well. Health and safety standards are issued and enforced, primarily by the U.S Department of Labor. The first step, as indicated, is the publication of health and safety standards which all covered employers are expected to know about and to follow. A relatively small force of federal safety inspectors makes unannounced inspections (553 Federal inspectors in 1973). Employers are fined upon discovery of violations, not for their failure to abate or to come to standard after inspection. Up until OSHA, safety laws usually gave employers a period of time to get up to standard, and if they did not comply within the time period they could then be fined. The plan of attack by the federal government was to designate five industries as high priority target industries in which inspectors were to be concentrated including: • Marine cargo handling

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
• Implementing the Law (2) (cont'd)		• Lumber and wood products • Transporation equipment • Roofing and sheetmetal • Meat and meat products The most important health hazards for which standards are to be set and enforced include asbestos (causing cancer of the lungs); cotton dust and silica (causing silicosis); lead (causing blood and nervous system maladies); carbon monoxide (causing brain damage). It is significant that 50 percent of all employee generated complaints in 1972 related to occupational health issues like those mentioned above.
• Coverage (2)		All employers are covered who have an effect on interstate commerce except those where safety is regulated by other laws such as in coal mining, railways, atomic energy, gas pipelines,or aviation. Public employees (state and federal) are not covered, as a general rule.
Required Duty Provisions (2)		Each covered employer has a general duty to provide a work setting that is free from "recognized hazards that are likely to cause death or serious harm to workers, even if such hazards are not covered by an OSHA standard." Also, each employer must comply with all the regulations and standards affecting his business or operation. Each employee has the duty to comply with safety and health standards, rules, regulations,and orders of the act.
• Administrative Overview (2)		The U.S. Secretary of Labor (Department of Labor) has the prime responsibility for establishing occupational safety and health standards, assisted by a new organization, the National Institute for Occupational Safety and Health, which is in the Department of Health, Education and Welfare. The National Institute is particularly concerned with occupational health hazards such as toxic materials. The U.S. Department of Labor is also responsible for enforcement procedures. Some states have been granted the power to make inspections and to insure compliance with the law when such states have agreed to be as rigorous in enforcement as the federal inspector.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
• Definition of a Standard and Its Use (2)		An occupational safety and health standard is a ruling or decision in writing as to conditions, circumstances, methods, and practices at work that are considered to be safe and healthful. Although changes are made from time to time, standards for all industries have been published. For example, the standard that has been set for head protection in the construction industry is #1926-100 Head Protection and states: "Employees working in areas where there is a possible danger of head injury from impact, or from falling or flying objects, or from electrical shock and burns, shall be protected by protective helmets." That is, hard hats.
• Inspections (2)		Government inspectors are authorized by law to make unannounced inspections. Priorities for inspections are as follows: • Situations where there is "imminent danger" (In other words, the very worst situations.) • In response to complaints by workers • The target industries previously specified • Random cross sections of all establishments covered by the law (There are 4,100,000 establishments covered by the law.)
• Penalties (2)		If the inspector believes an employer has violated some standard or rule he may be given a written citation which describes the violation. The employer may be fined up to $1,000 for each violation and up to $10,000 for "wilful or repeated" violations.
Importance of OSHA to Workers and Their Rights and Obligations (3)	Ask students to identify situations or hazards that might be labelled as imminent dangers. Use such examples as: • Ungrounded electrical equipment • Holes in a floor • Slippery floors	
• Basic Obligations (3)		Although the act does not levy penalties against individual workers, it is the individual's responsibility to comply with the provisions of the act and to work safely.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
• Employee Rights (3)	• Inadequate lighting • Unshored trenches Ask students to suggest reasons why some people object to wearing: • Hard hats • Safety goggles • Safety shoes	There are five basic rights given to employees (and/or their representatives) which include: • Requesting the Secretary of Labor to authorize an inspection if he believes there is imminent danger or if he believes there has been violation of a standard which threatens to cause physical harm • Accompanying the inspector on his rounds for purposes of aiding in the inspection. This is the "walk-around" right. In establishments with unions a union walk-arounder is designated in advance. When there is no union the inspector is supposed to talk with and question employees at random. • Appearing as a witness in hearings resulting from an inspection and citation • Observing how a company monitors and measures toxic or hazardous materials and substances. Employees are entitled to information about his own exposure over time to harmful substances. • Requesting the Secretary of Health, Education and Welfare to determine whether substances or materials used in his workplace are harmful • Being informed by the employer of his protections and obligations under the act • Being free of discrimination for using the provisions of the act. Employees may not be discharged, lose pay or in any way discriminated against because they used their rights under the act.
Employer Responsibilites (4) • Basic Duties (4) • Additional Duties (4)	Discuss with students the safety and health regulations that relate to the industries in which they are working. These standards may be obtained from the U.S. Department of Labor.	Employers are required to: • Furnish a safe place of employment, that is, "free from recognized hazards that are causing or are likely to cause death or serious harm to his employees" • Comply with the safety and health standards promulgated under the act. Employers are also required to: • Make, help, and preserve whatever records (statistics and information) prescribed by the OSHA administration

CONTENT	INSTRUCTIONAL SUGGESTIONS
• Additional Duties (4) (cont'd)	
Results and Consequences of the Act (5)	
• Criticisms (5)	
• Reduced Accidents and Safer Conditions (5)	
• Increased Awareness of the Need For Employee Health and Safety (5)	

BACKGROUND INFORMATION

- Inform employees of their rights and obligations under the act
- Maintain accurate records of each employee who has been exposed to potentially toxic materials or harmful physical agents
- Provide training to their employees in the actual and potential hazards on the job and the equipment and practices to be used by employees to minimize the risk of hurting themselves or other employees

Some employers are fearful that if they live up to all the standards and rules of OSHA that their costs will soar, that productivity will suffer, or that they will not be able to deliver their products at the scheduled time. Most employers agree, of course, that safe and healthful working conditions are desirable, but they are not all agreed about the best ways to attain such an objective.

Unions, on the other hand, have been critical because the act has been implemented too cautiously and because the number of federal inspectors is too small to deal with the real needs.

Approximately three years after the passage of OSHA, no one was prepared to say that the incidence of work-related accidents or illnesses has been substantially reduced because of the provisions of OSHA. Hopefully, before too long, the statistics will indicate such a beneficial consequence.

In the past some employers may have overlooked some safety violations such as not wearing a hard hat or safety goggles. Since OSHA was passed and since employers may be fined rather large amounts of money, these employee violations are not being tolerated.

The lesson for an employee is clear — work safely so as to protect your own life and limb, but if that does not persuade you, remember that the boss today feels he has no choice except to discipline you quickly and sternly for violations.

UNIT 8

MODULE 2

ACCIDENT PREVENTION

Explains what is known about accident causation and prevention and clarifies individual worker responsibilities in regard to accidents

OBJECTIVES

At the completion of this module students will be able to:

1 *Explain the importance of accident prevention to a worker*

2 *Detail the causes of and factors relating to accidents*

3 *Summarize how accidents can be prevented*

4 *Distinguish the major facts about accident proneness*

5 *Identify good safety habits and their importance*

REFERENCES

(A) Maier, N.R. *Psychology in industry;* 3d ed. New York, N.Y. Houghton-Mifflin Co. 1965.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Importance of Accident Prevention (1) • Usually Harmful and Often Fatal (1) • Costs Money and Grief (1) • Many Accidents Can Be Prevented (1)	*Additional materials on accidents and accident prevention may be obtained from the National Safety Council, 425 North Michigan Ave. Chicago, Ill. 60611.*	It is quite obvious, but it needs to be repeated that accidents produce harmful consequences to individuals. If accidents were not harmful, if people did not suffer physical pain and permanent loss of life and limb, there would be relatively little concern with safety and accident prevention. Although most of us believe that accidents happen only to the other person, we all recognize that accidents involving people are undesirable. In money terms alone, accidents are costly because there are insurance costs, medical costs, and production costs. But none of these "social costs" can really be compared to the personal costs suffered by the individual who was involved in an accident. Although it sounds like a contradiction in terms to say that accidents can be prevented, it is true that there are relatively few completely unavoidable and unpredictable events at the work place. Certainly such true accidents occur from time to time, such as a sudden flash flood which may wipe out blocks of buildings or lightning may strike the building in which we work. These are the exceptions to the rule that most accidents, and particularly industrial accidents, can often be attributed to human error or failure.

CONTENT	INSTRUCTIONAL SUGGESTIONS
Causes and Factors Relating To Accidents (2)	Discuss with students how the work environment affects the chances of accidents occurring. (Ref. A, Chapter 16)
• Work Environment (2)	*Additional information that may be adapted to class use may be found on pages 85-86 of the April, 1972 issue of School Shop and on page 41 of the September 1975 issue of Industrial Education.*
• Coping with Environmental Hazards and Conditions (2)	
• People Cause Accidents (2)	
Accident Prevention (3)	
• Control or Change the Work Environment (3)	

BACKGROUND INFORMATION

Clearly, type of work setting relates to how safe or dangerous it is. The ironworker bolting steel girders together 20 stories above ground faces far more danger or risk than the draftsman who is working in an air-conditioned drafting room. Or to cite another extreme, the pattern maker who uses power woodworking machinery is constantly exposed to a more dangerous accident producing environment than is the barber cutting hair in his own shop.

Often the importance of the environment is overlooked or downgraded. Consider for a moment the dramatic fact that when the national speed limit for automobiles was placed at 55 miles per hour, the number of automobile accidents was almost immediately reduced by 25 percent.

One way to reduce accidents is to use the proper equipment along with safety devices. Tools and equipment are constantly being redesigned to permit their safer use. Electric hand drills are grounded better today and are almost shockproof. Machines have built-in guards. Automobiles are built to withstand the impact of collision, on the sound theory that they will continue to collide with one another.

The national government is engaged in a broad scale effort to raise safety and health standards by a process of education and of punishment for those employers who are not up to standard. Sometimes workers are physically restrained in an attempt to cope with industrial hazards. Thus, for example, workers who operate or maintain nuclear energy installations do so by remote control because of the great dangers from radiation.

While there is some argument about whether or not there are some people who are truly accident prone, thus causing most accidents, there is no disagreement about the fact that most accidents could have been prevented. In other words, most accidents were caused, and the human factor was very much in evidence.

As indicated, one approach to safety at work (this being the positive side of the topic of accident prevention) is to focus on the equipment, the setting, and situation. This approach produces seat belts and automobiles that will not start until the seat belt is properly fastened.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
• Improve Safety Standards (3)		The government needs to continue its program of improving the health and safety conditions of the workplace.
• Get Workers To Acquire Good Safety Habits (3)		This is the psychological approach which seeks to motivate people to acquire safe work attitudes and habits. Thus, we know that some persons were injured simply because they were careless, they were not wearing their safety shoes or their hard hat. The answer is to educate, inculcate, and indoctrinate a safe rather than a careless attitude, but the task is not yet completely understood. Consider, for example, that a beginner who is learning how to operate a grinder is more careful to use his goggles than is the person who has some experience and feels that the need for goggles has been exaggerated. Predictably, there is an accident.
Proneness to Accidents (4)		In theory, there are four reasons for accidents:
• Statistical Distribution (4)		• Accidents occur by chance, so whether or not a person has an accident is simply a matter of luck. • Accidents occur in some sort of a fair pattern so when a person has one accident, he can assume that that will be it • Once a person has an accident he becomes so upset that he is likely to have more. • Some individuals are going to have accidents because of their physical and psychological characteristics, that is, they are accident prone.
• Proneness to Accidents		As indicated above, there is some controversy about the importance of the human factor as a cause of accidents. Suffice it to say that the controversy turns on statistical interpretation of accident records. From a worker's perspective, the relevant facts are as follows: • Individuals who are not trained properly or who do not possess the necessary job skills will have accidents, such as the taxi driver who has poor depth perception.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
• Proneness to Accidents (4) (cont'd)		• Excessive physical stress such as extreme fatigue can cause accidents. • Excessive psychological stress carries over into work and may be related to accidents, such as having trouble with a wife or girlfriend and colliding with another auto. • Some persons are more exposed to dangerous situations than others. • It is probably more accurate to suggest that there is something called temporary accident proneness, that is, when the above factors appear and an accident happens.
Sound Safety Rules (5)		No attempt will be made here to enumerate each and every safety rule that was ever published. Instead, a few sensible precautions are listed as reminders such as: • Wear safety glasses as required. • Have no loose clothing which may get caught in moving machinery. • Wear hard hats as required. • Wear safety shoes as required. • Prohibit horseplay on the job. In the final analysis, each and every individual is responsible for developing and maintaining sound safety habits. No matter how many safety posters are on the bulletin board or how many grim movies are shown it is the individual worker who must be motivated to save his own skin. Good safety habits can be learned and, once acquired, are built-in mechanisms that force people to do certain things in certain ways for their protection. Consider the airplane pilot, who, before taking off, systematically checks off, by inspecting and checking, every critical piece of equipment on the airplane. Only after this checkoff is he allowed to take off. He has acquired sound safety habits.

FIRST AID

Explains what every apprentice must know about first aid and encourages all apprentices to obtain qualified professional training in first aid

OBJECTIVES

At the completion of this module students will be able to:

1 *Cite an employer's responsibility for first aid under the provisions of OSHA*

2 *List the areas of knowledge that apprentices should have about first aid*

3 *Specify where and how first aid training may be obtained*

4 *List and explain the minimum knowledge of first aid required by all apprentices*

REFERENCES

(A) American National Red Cross. *Standard first aid and personal safety.* Garden City, N.Y. Doubleday and Co., Inc. 1973.

(B) _____. *Standard multimedia first aid course.* Garden City, N.Y. Doubleday and Co., Inc. 1968.

CONTENT	INSTRUCTIONAL SUGGESTIONS
Employer's Responsibility for Providing First Aid Services (1)	*Use this module as a means of motivating class members to enroll in at least a standard first aid course.*

BACKGROUND INFORMATION

In the Federal Register Vol. 39 under subject K 1910.151 found on page 23652 it states:

"The employer shall ensure the ready availability of medical personnel for advice and consultation on matters of plant health.

"In the absence of an infirmary, clinic, or hospital in near proximity to the workplace which is used for the treatment of all injured employees, a person or persons shall be adequately trained to render first aid. First aid supplies approved by the consulting physician shall be readily available.

"Where the eyes or body of any person may be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use."

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Important Areas of Content Relating to First Aid (2)		There are all kinds of accidents that can and do occur, including falls and falling, burns, asphyxiation, and all manner of cuts and scratches. First aid refers to the skill and knowledge which can be learned by all persons to deal immediately and effectively with such emergencies. First aid fundamentals include: • Control of bleeding • Cuts, bruises, wounds, burns, scalds • Foreign substances in eyes, ear, nose, throat • Artificial respiration • Fainting and physical shock • Fractures and dislocations • Transportation of the injured • Sources of professional help Any real knowledge of first aid is useful. The minimum amount of time prescribed by the American Red Cross for emergency first aid training programs is 10 hours, but they recommend a more thorough course of 20 hours duration.
First Aid Courses (3) • Red Cross (3)		The American Red Cross has a long-standing interest in training people to deal with emergencies. Their short (10 hour) course helps a person to deal with an injured person until professional medical help arrives, as for example, in the control of bleeding and artificial respiration. The 20- or 50- hour course prepares persons at more a sophisticated level of knowledge. Red Cross personnel are more than willing to set up training programs wherever and whenever there are people interested in learning about first aid.
• Educational Institutions (3)		Many community colleges and other educational institutions can and do provide courses in first aid as a part of their curricular offerings.

CONTENT	INSTRUCTIONAL SUGGESTIONS
• Federal Government (3)	
Minimum Knowledge (4)	

BACKGROUND INFORMATION

As a part of its responsibility for occupational safety and health, the federal government has developed standards for first aid courses and in many cases training materials as well.

The following may be considered as first aid rules:

- Never neglect a personal injury no matter how minor it seems.
- Do not move a person who has been injured unless you are trained in how to transport the injured.
- Infection such as lockjaw can occur so see a doctor as soon as possible after any injury.
- Shock usually goes along with serious injury. Without moving the patient, cover the person with a blanket. Do not provide food or drink.
- Stop bleeding by placing pressure on the artery between the wound and the heart with a clean cloth.
- Give artificial respiration immediately in cases of drowning, suffocation, electric shock, and continue for an hour or two if necessary.
- Know where first aid kits are available.
- Know who is qualified in first aid and where such an individual may be located.
- Obtain qualified help.

UNIT 8

MODULE 4

ACCIDENT REPORTS: IMPORTANCE, USE, AND HOW WRITTEN

Explains what accident reports are used for, why they are important, and how they are written.

OBJECTIVES

At the completion of this module students will be able to:

1 *State the uses and importance of accident reports to employers*

2 *State the uses and importance of accident reports to employees*

3 *Correctly fill out a first aid report form*

4 *Identify and describe the types of information about an accident needed to fill out a supervisor's accident report*

REFERENCES

(A) National Safety Council. *Accident prevention manual for industrial operations;* 6th ed. Chicago, Ill. The Council. 1969.

(B) _____. *Supervisors safety manual;* 4th ed. Chicago, Ill. The Council. 1973.

CONTENT	INSTRUCTIONAL SUGGESTIONS
Importance and Uses of Accident Reports to Employers (1)	Discuss with students the important uses made of accident reports. (Ref. A; Ref. B)
• Improve Conditions at Workplace (1)	
• Information for Safety Programs (1)	
• Identification of Problem Areas (1)	

BACKGROUND INFORMATION

Firms and companies want to make their workplaces safe. Injuries are costly to employers because of higher insurance ratings, time lost from the job by injured employees, and materials wasted. Identifying causes of accidents is important because the employer can then act to reduce the number of accidents and make the workplace safer. If an employer cannot identify causes of accidents he can do nothing to prevent them. If he can do nothing to prevent them, he will have to bear the costs of accidents and possibly the reputation of being an unsafe employer.

Most employers want to know if their safety programs are effective. One way of telling whether or not a program is effective is to determine whether or not the number of accidents has decreased since the beginning of a program.

Problem areas for safety in the workplace are those areas where the accident rate is high, or where the rate is going up. A good employer or supervisor will keep track of accident rates to determine the need for training, safety devices on equipment, and better supervision.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Importance and Uses of Accidents Reports to Employers (2)		A safe workplace is important to employees. If injured, an employee has either permanent or temporary difficulty earning a living. Workman's Compensation pays an injured employee only part of his former wages, and may cover only part of his medical expenses. Reporting accidents to an employer or supervisor helps him to keep a safe workplace and helps the employee to keep his earning power.
• Improve Conditions at Workplace (2)		
• Obtain Rightful Benefits (2)		If an employee does not report an accident, he may have difficulty collecting medical and other benefits to which he may be entitled. Most employers are covered by insurance companies for employee injuries. It is difficult for these companies to pay claims on accidents which have not been reported. This may not be much of a problem for an employee with a small injury. However, small injuries can turn into big ones (infected cuts, back injuries, and sprains). If an employee does not report a small injury, he may have difficulty getting benefits if that injury becomes serious.
• First Aid Report (3)	Obtain some first aid forms from employers and distribute them to the students. Have students assume the role of a first aid attendant and complete a first aid report based on several hypothetical "cases" prepared by the instructor.	A first aid report is usually filled out by a first aid attendant when an injured employee is treated. It is a form asking for basic information of the injured employee, such as name, department, occupation, foreman, sex of injured person. Additionally, the form will ask the date and time of the injury, what the injury was, and how the employee sustained the injury. This information is more useful to employers and employees if it is accurate and specific.
Accident Report (4)		
• Equipment Involved (4)		Depending on the accident, this could be a piece of power equipment, a hand tool, a heavy crate, box, a caustic solution, or a ladder. The person who reads the report and uses it to improve safety conditions needs to know what equipment or materials were involved.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
• Type of Accident (4)	Obtain some accident report forms from employers and distribute to the students. Have students role play situations where an injured worker presents himself to the designated person to report an accident. The student portraying the injured worker should be thoroughly prepared so that his responses to questions are realistic.	This information involves how the person became injured. Examples include tripping, falling, straining a muscle, or being hit or struck by an object. This information is often used to compile accident rates for various types of accidents.
• Conditions (4)		This information includes what was unsafe about the equipment or material being used. Examples are a broken ladder rung, a hammer with a split handle, a mushroomed handle on a cold chisel, unguarded drive belts and gears, or slippery walking surfaces.
• Circumstances (4)		This information involves the actions of the injured person, or others, which may have caused or contributed to the accident. Examples include repairing or maintaining moving equipment without first shutting it off, backing a vehicle without checking to see if people are behind it, or operating machinery without the guards in place.
• Reasons (4)		This information explains why the person acted unsafely. Examples include being in a hurry, doing something the person was not qualified to do, being emotionally upset, or not following instructions.

UNIT 8

MODULE 5

ENVIRONMENT CONTROL AND HAZARDOUS MATERIALS

Identifies major hazardous materials; explains why they are hazardous, and specifies good work practices and habits to follow when dealing with hazardous materials

OBJECTIVES

At the completion of this module students will be able to:

1 *Define environmental health problems and hazardous materials*

2 *Indicate the scope or parameters of these hazards*

3 *List and explain the meaning of common warning signs*

4 *Describe the major health hazards as defined by OSHA*

5 *Describe hazardous materials as categorized by OSHA*

6 *Explain good housekeeping and personal habits for dealing with these hazards*

REFERENCES

(A) General Services Adminstration, Office of the Federal Register. *Code of federal regulations, 29, labor, parts 1900 to 1919.* Washington, D.C. U.S. Government Printing Office. 1975.

(B) _____. *Code of federal regulations, 29 labor part 1920 to end.* Washington, D.C. U.S. Government Printing Office. 1975.

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CONTENT	INSTRUCTIONAL SUGGESTIONS
Environmental Health Problems (1)	*Determine the various occupations represented by the students and relate the content in this module to those employment situations.* *Additional information may be found in Part 1910-Occupational Safety and Health Standards in the latest issue of Reference A. Topics listed in the 1975 issue of Reference A are given at the end of this module.*

BACKGROUND INFORMATION

While safety hazards are usually quite easy to recognize, as for example, a shop floor covered with oil and grease, health hazards are not so easily recognized. Very small amounts of toxic materials can accumulate in the body over a long period of time, after which they cause illness or death. Other substances can cause health problems years later, even after a relatively short exposure. Environmental health problems are those caused by pollutants or toxic substances such as air contaminants, asbestos fibers, carcinogens, radiation, and even excessive noise.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Hazardous Materials (1)	*Additional information may be found in Part 1910 - Occupational Safety and Health Standards, Subpart H - Hazardous Materials in the latest issue of Reference A.*	Hazardous materials in contrast to the environmental health hazards are dangerous because they are highly flammable, volatile, or explosive. Some hazardous materials are acetylene, oxygen, gasoline, and explosives.
Scope of Hazards (2)	*Additional information may be found in Part 1910 - Occupational Safety and Health Standards, Subpart Z - Toxic and Hazardous substances in the latest issue of Reference A.*	
• Toxic Substances (2)		The National Institute for Occupational Safety and Health identified more than 13,000 potentially toxic substances and harmful physical agents by 1972. In 1972, there were approximately 400 health standards established by the safety and health researchers.
• Identification of a Substance as Dangerous (2)		While it is now clear that long-term exposure to toxic substances can cause sometimes fatal damage to the bodily organs of persons who are exposed, it is often difficult to pin down when a substance is dangerous. In 1974, after it was discovered that seven workers had died of liver cancer after years of working on vinyl chloride operations in chemical companies, the OSHA standard for exposure to vinyl chloride which had been set at 500 parts per million was reduced to 50 p.p.m., with serious discussion being given to making it zero. This reaction resulted as it became clearer that there was a link between vinyl chloride and liver damage.
Warning Labels and Signs (3)	*Additional information may be found in Part 1910 - Occupational Safety and Health Standards, Subject J - General Environment Controls in the latest issue of Reference A.*	The following labels are suggested for use with these substances: • Asbestos CAUTION Contains Asbestos Fibers Avoid Creating Dust Breathing Asbestos Dust May Cause Serious Bodily Harm

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Warning Labels and Signs (3) (cont'd)		• Carcinogens DANGER Contaminated with Cancer-Producing Agent • Radiation CAUTION Radioactive Materials • Explosives EXPLOSIVES • Flammables FLAMMABLE
Major Health Hazards (4)	*Additional information may be found in Part 1910 - Occupational Safety and Health Standards, Subpart Z - Topic and Hazardous Substances in the latest issue of Reference A.*	The following have been identified by OSHA as high priority health hazards: • Asbestos (over 200,000 workers exposed) • Cotton Dust (over 800,000 workers exposed) • Silica (over 1.1 million workers exposed) • Lead (over 1.6 million workers exposed) • Carbon Monoxide (unknown number of workers exposed) The following have been identified by OSHA as major health hazards: • Air Contaminants • Asbestos • Coal Tar Pitch Volatiles • Carcinogens • Occupational Noise • Ionizing Radiation • Non-ionizing radiation
Hazardous Materials (5)	*Additional information may be found in Part 1910 - Occupational Safety and Health Standards, Subpart H - Hazardous Materials in the latest issue of Reference A.*	The following have been identified by OSHA as hazardous materials: • Compressed gases • Acetylene • Hydrogen • Oxygen • Anhydrous Ammonia • Nitrous oxide • Flammable and Combustible liquids • Explosive and blasting agents • Liquified petroleum gases

CONTENT	INSTRUCTIONAL SUGGESTIONS
Good House-keeping and Personal Habits (6)	Emphasize the importance of developing and maintaining proper attitudes and good personal habits relative to hazardous materials.

BACKGROUND INFORMATION

At a minimum the following precautions are required of all workers:

- Recognize and heed warning signs. When it says NO SMOKING that's exactly what it means; when it says TURN OFF TWO WAY RADIOS that is what it means.
- Use the prescribed protective clothing and equipment. Spray masks are uncomfortable, but polluted lungs are worse.
- Do not spend time idly in contaminating or dangerous areas.
- Keep track of your exposure to dangerous toxic substances.
- Store and use dangerous materials in approved ways, containers and locations.
- Use tools, equipment, and materials as prescribed.
- Notify your employer of dangerous conditions and hazards.
- Be cautious and be safe.
- Do not add to the dangers by your own sloppy housekeeping. For example, dispose of oily rags and waste or keep them in tightly closed metal containers.

PART 1910—OCCUPATIONAL SAFETY AND HEALTH STANDARDS*

Subpart A—General

Sec.
1910.1 Purpose and scope.
1910.2 Definitions.
1910.3 Petitions for the issuance, amendment, or repeal of a standard.
1910.4 Amendments to this part.
1910.5 Applicability of standards.
1910.6 Incorporation by reference.

Subpart B—Adoption and Extension of Established Federal Standards

1910.11 Scope and purpose.
1910.12 Construction work.
1910.13 Ship repairing.
1910.14 Shipbuilding.
1910.15 Shipbreaking.
1910.16 Longshoring.
1910.17 Effective dates.
1910.18 Changes in established Federal standards.
1910.19 Asbestos dust.

Subpart C—[Reserved]

Subpart D—Walking-Working Surfaces

1910.21 Definitions.
1910.22 General requirements.
1910.23 Guarding floor and wall openings and holes.
1910.24 Fixed industrial stairs.
1910.25 Portable wood ladders.
1910.26 Portable metal ladders.
1910.27 Fixed ladders.
1910.28 Safety requirements for scaffolding.
1910.29 Manually propelled mobile ladder stands and scaffolds (towers).
1910.30 Other working surfaces.
1910.31 Sources of standards.
1910.32 Standards organizations.

Subpart E—Means of Egress

1910.35 Definitions.
1910.36 General requirements.
1910.37 Means of egress, general.
1910.38 Specific means of egress requirements by occupancy. [Reserved]
1910.39 Sources of standards.
1910.40 Standards organizations.

Subpart F—Powered Platforms, Manlifts and Vehicle-Mounted Work Platforms

1910.66 Power platforms for exterior building maintenance.
1910.67 Vehicle-mounted elevating and rotating work platforms.
1910.68 Manlifts.
1910.69 Sources of standards.
1910.70 Standards organizations.

Subpart G—Occupational Health and Environmental Control

Sec.
1910.94 Ventilation.
1910.95 Occupational noise exposure.
1910.96 Ionizing radiation.
1910.97 Nonionizing radiation.
1910.98 Effective dates.
1910.99 Sources of standards.
1910.100 Standards organizations.

Subpart H—Hazardous Materials

1910.101 Compressed gases (general requirements).
1910.102 Acetylene.
1910.103 Hydrogen.
1910.104 Oxygen.
1910.105 Nitrous oxide.
1910.106 Flammable and combustible liquids.
1910.107 Spray finishing using flammable and combustible materials.
1910.108 Dip tanks containing flammable or combustible liquids.
1910.109 Explosives and blasting agents.
1910.110 Storage and handling of liquified petroleum gases.
1910.111 Storage and handling of anhydrous ammonia.
1910.112 [Reserved]
1910.113 [Reserved]
1910.114 Effective dates.
1910.115 Sources of standards.
1910.116 Standards organizations.

Subpart I—Personal Protective Equipment

1910.132 General requirements.
1910.133 Eye and face protection.
1910.134 Respiratory protection.
1910.135 Occupational head protection.
1910.136 Occupational foot protection.
1910.137 Electrical protective devices.
1910.138 Effective dates.
1910.139 Sources of standards.
1910.140 Standards organizations.

Subpart J—General Environmental Controls

1910.141 Sanitation.
1910.142 Temporary labor camps.
1910.143 Nonwater carriage disposal systems.
1910.144 Safety color code for marking physical hazards.
1910.145 Specifications for accident prevention signs and tags.
1910.146 [Reserved]
1910.147 Sources of standards.
1910.148 Standards organizations.
1910.149 Effective dates.

Subpart K—Medical and First Aid

1910.151 Medical services and first aid.
1910.152 [Reserved]
1910.153 Sources of standards.

Subpart L—Fire Protection

Sec.
1910.156 Definitions applicable to this subpart.

PORTABLE FIRE SUPPRESSION EQUIPMENT

1910.157 Portable fire extinguishers.
1910.158 Standpipe and hose systems.

FIXED FIRE SUPPRESSION EQUIPMENT

1910.159 Automatic sprinkler systems.
1910.160 Fixed dry chemical extinguishing systems.
1910.161 Carbon dioxide extinguishing systems.
1910.162 Other special fixed extinguishing systems. [Reserved]

OTHER FIRE PROTECTION SYSTEMS

1910.163 Local fire alarm signaling systems.
1910.164 Fire brigades. [Reserved]
1910.165 Effective dates.
1910.165a Sources of standards.
1910.165b Standards organizations.

Subpart M—Compressed Gas and Compressed Air Equipment

1910.166 Inspection of compressed gas cylinders.
1910.167 Safety relief devices for compressed gas cylinders.
1910.168 Safety relief devices for cargo and portable tanks storing compressed gases.
1910.169 Air receivers.
1910.170 Sources of standards.
1910.171 Standards organizations.

Subpart N—Materials Handling and Storage

1910.176 Handling materials—general.
1910.177 [Reserved]
1910.178 Powered industrial trucks.
1910.179 Overhead and gantry cranes.
1910.180 Crawler, locomotive, and truck cranes.
1910.181 Derricks.
1910.182 Effective dates.
1910.183 Helicopters.
1910.184 Slings.
1910.189 Sources of standards.
1910.190 Standards organizations.

Subpart O—Machinery and Machine Guarding

1910.211 Definitions.
1910.212 General requirements for all machines.
1910.213 Woodworking machinery requirements.
1910.214 Cooperage machinery.
1910.215 Abrasive wheel machinery.
1910.216 Mills and calenders in the rubber and plastics industries.
1910.217 Mechanical power presses.
1910.218 Forging machines.
1910.219 Mechanical power-transmission apparatus.
1910.220 Effective dates.
1910.221 Sources of standards.
1910.222 Standards organizations.

Subpart P—Hand and Portable Powered Tools and Other Hand-Held Equipment

1910.241 Definitions.
1910.242 Hand and portable powered tools and equipment, general.
1910.243 Guarding of portable powered tools.
1910.244 Other portable tools and equipment.
1910.245 Effective dates.
1910.246 Sources of standards.
1910.247 Standards organizations.

Subpart Q—Welding, Cutting and Brazing

1910.251 Definitions.
1910.252 Welding, cutting and brazing.
1910.253 Sources of standards
1910.254 Standards organizations.

Subpart R—Special Industries

1910.261 Pulp, paper, and paperboard mills.
1910.262 Textiles.
1910.263 Bakery equipment.
1910.264 Laundry machinery and operations.
1910.265 Sawmills.
1910.266 Pulpwood logging.
1910.267 Agricultural operations.
1910.268 Sources of standards.
1910.269 Standards organizations.
1910.274 Sources of standards.
1910.275 Standards organizations.

Subpart S—Electrical

1910.308 Application.
1910.309 National Electrical Code.

Subpart Z—Toxic and Hazardous Substances

1910.1000 Air Contaminants.
1910.1001 Asbestos.
1910.1002 Coal tar pitch volatiles; interpretation of term.
1910.1003 4-Nitrobiphenyl.
1910.1004 alpha-Naphthylamine.
1910.1005 4,4'—Methylene bis (2-chloroaniline).
1910.1006 Methyl chloromethyl ether.
1910.1007 3,3'—Dichlorobenzidine (and its salts).
1910.1008 bis-Chloromethyl ether.
1910.1009 beta-Naphthylamine.
1910.1010 Benzidine.
1910.1011 4-Aminodiphenyl.
1910.1012 Ethyleneimine.
1910.1013 beta-Propiolactone.
1910.1014 2-Acetylaminofluorene.
1910.1015 4-Dimethylaminoazobenzene.
1910.1016 N-Nitrosodimethylamine.
1910.1017 Vinyl chloride.

* Code of Federal Regulations, 29 Labor, Parts 1900-1919, (Washington, D.C., 1975), pp. 55-56.

UNIT 8

MODULE 6

FIRES: HOW TO PREVENT, CONTROL, AND MINIMIZE LOSSES

Explains causes of fires, how to prevent them, and procedures to follow to minimize losses from fires

OBJECTIVES

At the completion of this module students will be able to:

1 *Identify the three components of combustion and the forms in which they can occur*

2 *Describe methods of preventing fires from occurring, and explain why these methods will prevent fires from occurring*

3 *State routine procedures necessary to minimize loss of life and property from fires*

4 *State the procedures to be followed in case of fire*

5 *Explain the four classes of fires, and the types of fire extinguishers to be used in each situation*

REFERENCES

(A) National Safety Council. *Supervisors safety manual;* 4th ed. Chicago, Ill. The Council. 1973.

(B) Sax, N.I. *Dangerous properties of industrial materials;* 3d ed. New York, N.Y. Van Nostrand Reinhold Co. 1968.

CONTENT	INSTRUCTIONAL SUGGESTIONS
Components of Combustion (1)	
• Oxygen (1)	
• Fuel (1)	
• Heat (1)	

BACKGROUND INFORMATION

The three components necessary for combustion are: oxygen, fuel, and heat.

Oxygen is present in the atmosphere and may also be present in concentrated quantities where it is used in manufacturing processes such as welding. In general, the more oxygen a fire has to use, the more rapidly it will burn.

Fuel or flammable material is any substance which will burn. It may be solid, liquid,or gas. Some fuels, such as gasoline or certain types of dust which mix easily with oxygen,may burn so rapidly that an explosion results.

Heat or ignition is necessary in order to start a fire with fuel and oxygen. Once started, a fire generates its own heat. The following are common sources of ignition in industrial settings: open flames, electrical equipment malfunctions, friction, smoking and matches, hot surfaces, static electricity, overheating, and spontaneous ignition.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Fire Prevention (2)	*Relate this information to the student's workplace emphasizing any special hazards that may exist. (Ref. A, pp. 315-327; Ref. 3, 196-199)*	Fire prevention involves keeping the three components of combustion, heat or ignition, fuel, and oxygen from occurring at the same place at the same time. Because it usually is difficult to control the presence of oxygen, fire prevention usually consists of keeping heat or ignition separate from fuel and oxygen, or keeping fuel separate from heat or ignition and oxygen.
• Theory (2)		
• Controlling Fuel or Flammable Material in Presence of Heat and Oxygen (2)		Controlling fuel or flammable material in the presence of heat or ignition and oxygen can prevent the occurrence of fires. Keep work areas free of litter. Dispose of trash properly. Keep flammable solid materials away from heat sources such as hot pipes, torches, and furnaces. Protect flammable solids from heat with shields. Store flammable liquids in closed, vented containers painted a distinctive color and labeled with the name of the liquid. Store these containers in a fire resistant or fire proof cabinet or locker. Keep areas well vented where flammable liquids are used. Do not allow high concentrations of dust to build up in closed areas.
• Controlling Heat in the Presence of Fuel and Oxygen (2)		Fires can also be prevented by controlling heat or ignition in the presence of fuel and oxygen.
· Open Flames		Do not use cutting and welding equipment or gas and oil burners in the presence of vapors. Shield flammable material from open flames.
· Electrical Equipment		Electrical equipment can cause fires by sparking or overheating. Follow National Electrical Code specifications when ordering and installing electrical equipment. Maintain electrical equipment on a regular maintenance schedule. Use special equipment where there is a hazard of fire or explosion. Do not overload wiring circuits. Do not tamper with electrical wiring or circuits.

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CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
• Friction (2)		Common sources of friction are overheated bearings, grinding processes, fans or impellers rubbing on housings. Heat from friction can ignite vapors and gases, and flammable materials. Inspect and lubricate machinery regularly. Carry out processes which generate heat from friction away from flammable materials and liquids.
• Smoking and Matches (2)		Smoking creates open flames, sparks, and glowing ashes, any one of which can ignite vapors, gases,or flammable materials. Smoke only in designated areas. Make sure that butts and matches are out. Dispose of butts and matches properly.
• Hot Surfaces (2)		Hot surfaces such as furnace or dryer housings, ducts, electric lamps,and irons may ignite vapors and gases and flammable materials. Provide sufficient air clearance or use shields or insulation to prevent the ignition of flammable materials. Do not use hot apparatus in the presence of vapors or gases. Also, provide adequate ventilation to carry the heat away from the hot surfaces.
• Overheated Materials (2)		Overheated materials can occur in processes involving heat, such as drying and heating. Have trained, careful supervisors inspect these processes. Install and use automatic temperature controls. Watch for signs of overheating such as glowing, smoke, or odors.
• Static Electricity (2)		Static electricity occurs in rolling or rubbing processes or where liquid flows from pipes. Use static eliminators or ground equipment or humidify the atmosphere to reduce the possibility of sparks jumping and igniting combustible materials.
• Spontaneous Ignition (2)		Spontaneous ignition occurs as a result of chemical action which creates heat. Such chemical action often takes place in deposits in ducts and flues, industrial wastes, oily rubbish, and in stored materials. Clean flues and ducts frequently. Empty waste containers daily. Isolate materials likely to heat spontaneously.
Procedures To Follow To Minimize Losses (3)	*Relate this information to the specific situations in which the students are employed.* (Ref. A, pp. 307-328; Ref. B, pp. 197-199)	A worker has a responsibility to protect his own life and the lives of others. Do not block exits, fire lanes, or fire escapes. Do not block fire doors open. Know the location of exits and fire escapes at the workplace.
• Exits and Escapes (3)		

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
• Equipment and Alarm Systems (3)	*Invite a representative of the local fire department to give a demonstration of fire extinguishing equipment.*	Fire fighting and protection equipment at the workplace may include fire extinguishers, automatic sprinklers, and alarm systems. All workers should know the location of fire fighting equipment. All missing,damaged, or malfunctioning equipment should be reported to the proper authority. Do not tamper with equipment. Do not block equipment from view or access. Know how to operate fire extinguishers. Do not obstruct automatic sprinkler heads.
• Reporting Fires (3)		A worker should know how, when,and where to report a fire.
Procedures to Follow in Case of a Fire (4)	Determine and explain the fire fighting and evacuation procedures that exist at each student's workplace. (Ref. A, pp. 328-330; Ref. B, pp. 201-202)	
• Turn in Alarm (4)		Turn in alarm as quickly as possible, even if the fire is small. This may involve making a telephone call or pulling a lever.
• Fight the Fire (4)		If the worker believes that he can put the fire out with apparatus at the workplace, he should do so being careful not to let the fire get between him and the exit.
• Evacuation (4)		If the worker cannot put the fire out, he should leave the building at once, and stay a safe distance from it.
Classes of Fires (5)	*Invite a representative of the local fire department to demonstrate how to control and extinguish different types of fires.* (Ref. A, pp. 329-330; Ref. B, p. 194)	
• Class A		Class A fires occur with ordinary combustible materials such as wood, paper, and cloth. Class A fires are put out effectively with water, which deprives the fire of heat and oxygen.
• Class B		Class B fires involve flammable liquids, greases, oils, and solvents. Class B fires can be put out with carbon dioxide or dry chemical extinguishers which deprive the fire of oxygen.
• Class C		Class C fires occur in or near electrical equipment. Carbon dioxide or dry chemical extinguishers will put out this type of fire by depriving the fire of oxygen. Direct streams of water, such as from a hose or pail,should not be used because of the shock hazard.
• Class D		Class D fires involve combustible metals such as lithium, magnesium, and sodium. Extinguishing these fires involves special materials and techniques.

UNIT 8

MODULE 7

PERSONAL PROTECTIVE EQUIPMENT: HOW AND WHEN TO USE IT

Explains the various types of personal protective equipment and under what conditions and how protective equipment should be worn

OBJECTIVES

At the completion of this module students will be able to:

1 *State the general purpose of personal protective equipment*

2 *Identify types of protective eye equipment, state under what conditions they should be worn, and demonstrate their use*

3 *Identify types of protective head equipment, when they should be used, how they are maintained, and demonstrate their use*

4 *Identify types of protective foot equipment, and state under what conditions they should be worn*

5 *Identify types of protective hand equipment and state under what conditions they should be worn*

6 *Identify types of protective ear equipment and state under what conditions they should be used*

7 *Identify types of respiratory protective equipment and state under what conditions their use is appropriate*

REFERENCES

(A) National Safety Council. *Accident prevention manual for industrial operations;* 6th ed. Chicago, Ill. The Council. 1969.

(B) _____. *Supervisors safety manual;* 4th ed. Chicago, Ill. The Council. 1973.

CONTENT	INSTRUCTIONAL SUGGESTIONS
Purpose of Personal Protective Equipment (1)	

BACKGROUND INFORMATION

The purpose of personal protective equipment is to protect the body from work hazards which cannot be eliminated or which are difficult to eliminate. Protective equipment is not a substitute for safety engineering or safe work practices. It is worn to protect the worker in case an accident does occur. The safety conscious worker does not take chances with protective equipment on, or with it off.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Types of Protective Eye Protection (2)	Have protective eye equipment available and demonstrate the fitting and use of the various types of protective equipment in general use. Give students time to try on the different pieces of protective equipment. (Ref. A, pp. 1142-1145, 1155-1160; Ref. B, pp. 134-142)	Workers use eye protective equipment to protect their eyes from light, dust, fumes, flying objects or particles, or splashed from harmful liquids. Eye protection equipment should be comfortable, clean, and free from cracks.
• Safety Glasses (2)		Safety glasses look like ordinary eyeglasses. They have heat-treated, shatterproof lenses and protect the wearer's eyes from flying particles coming directly toward the worker's eyes. Where particles come toward the side of the worker's face, he should wear some other type of eye protection. Safety glasses are worn like ordinary eyeglasses. Safety glasses with side shields offer added protection for the eyes.
• Chipping Goggles (2)		Chipping goggles protect the wearer's eyes from flying particles coming from all angles. They are used during riveting, chipping, machining, or heavy grinding. They have clear lenses and are held in place with an elastic headband or strap.
• Welding Goggles (2)		Welding goggles may look like cover goggles with dark lenses to filter out harmful light. They should be worn during oxyacetylene welding, cutting, and brazing. Like cover goggles they are held in place with an elastic strap.
• Chemical Splash Goggles (2)		The chemical splash goggle is a specialized goggle with one wide lens worn for eye protection against chemical splashes and mist. It is held in place with an elastic strap.
Types of Protective Face Equipment (3)	Have protective face equipment available and demonstrate the fitting and use of the various types in general use. (Ref. A pp. 1160-1164; Ref. B, pp. 143-145)	Face protection protects the user's face from heat, chemical or metal splashes, and light impacts, and other hazards.
• Face Shields (3)		Clear plastic face shields protect the user's face during sanding, buffing, and handling chemicals. Metal face screens protect the face from heat and are used around heating furnaces and blast furnaces.
• Welding Helmets (3)		Welding helmets protect the eyes from sparks, flying particles, and molten metal. Their lenses protect the eyes from harmful light and radiation.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Types of Protective Head Equipment (4)	Have protective head equipment available and demonstrate the use of various types in general use. (Ref. A, pp. 1145-1151; Ref. B, pp. 152-156)	Safety hats or helmets are used to protect heads from bumps and from flying or falling objects. Aluminum hats will protect heads from impact but not from electric shock. Cradles and headbands hold the hat on the head, and should be replaced when deteriorated or badly soiled.
Types of Protective Foot Equipment (5)	Have protective food equipment available and demonstrate the use of the various types in general use. (Ref. A, pp. 1190-1193; Ref. B, pp. 147-151)	Feet need to be protected from heat, protruding objects such as nails, impacts, and crushing weights. This is accomplished by using various types of safety shoes and other types of protective equipment.
• Safety Shoes (5)		Safety shoes commonly have toe guards or "boxes" which protect toes from crushing weight or impact. Safety shoes may also have reinforced soles to protect feet from nails. Other special types of shoes are metal free shoes, used where there are electrical or explosion hazards, gaiter type shoes for welding, and wood soled shoes for work on hot or wet walking surfaces.
• Other Types of Foot Protection (5)		Metal shoe guards protect the front halves of the wearer's feet and are held in place by leather straps as are metatarsal flaps. Both metal shoe guards and metatarsal flaps should be worn on jobs which require carrying or handling heavy objects such as large ingots and heavy castings.
Types of Protective Hand Equipment (6)	Have protective hand equipment available and demonstrate the use of the various types in general use. (Ref. A, pp. 1196-1199; Ref. B. pp. 159-161)	In the course of work, hands may be burned, braised, cut, or scratched. Because practically all types of work require the use of hands, hand injuries can, at a minimum, be painful and annoying. Several types of gloves are generally available. Cotton fabric gloves protect against scrapes, dirt, and slivers. They are not generally suitable for heavy duty use. Leather gloves are suitable for heavy duty use. In addition, they protect against sparks, light impacts, and moderate heat. Asbestos gloves are used by workers who must continually handle hot objects. Metal mesh gloves protect against sharp edges and moderate impacts. Vinyl, rubber, and neoprene gloves protect hands from some chemicals and corrosives.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Types of Protective Ear Equipment (7)	*Invite a company physician, engineer, or safety inspector to give a short talk on preventing hearing loss.* (Ref. A, pp. 1151-1155; Ref. B, pp. 156-159)	Exposure to sustained or frequent loud noise can cause partial or total deafness. High frequency (pitch) noise is generally more harmful to hearing than low frequency noise. Noise hazards should be analyzed by trained men who can recommend proper ear protection. The two basic types of protective ear equipment include plugs, which fit into the ear canal, and ear muffs, which are worn externally. If a student believes that the noise at his workplace is potentially harmful, he should see his supervisor.
Types of Protective Respiratory Equipment (8)	*Invite a company physician, engineer, safety inspector, or member of the local fire department to give a short talk on protective respiratory equipment.* (Ref. A, pp. 1168-1185; Ref. B, pp. 162-170)	

LADDERS AND SCAFFOLDS: TYPES, USE, AND MAINTENANCE

Identifies various types of ladders and scaffolds and explains and demonstrates their uses

OBJECTIVES

At the completion of this module students will be able to:

1 *Identify and describe the characteristics of various types of ladders*

2 *Perform a safety check of various types of ladders*

3 *List and demonstrate correct placement of portable ladders*

4 *List and demonstrate correct procedures for use of ladders*

5 *Identify and describe the characteristics of various types of scaffolding*

6 *List and explain correct procedures for use of scaffolds*

REFERENCES

(A) National Safety Council. *Accident prevention manual for industrial operations.* 6th ed. Chicago, Ill. The Council. 1969.

(B) U.S. Navy, Bureau of Naval Personnel. *Basic construction techniques for houses and small buildings.* New York, N.Y. Dover Publications, Inc. 1970.

CONTENT	INSTRUCTIONAL SUGGESTIONS
Characteristics of Ladders (1) • Stepladder (1) • Single Portable Ladder (1) • Extension Ladder (1) • Fixed Ladder (1)	*Obtain examples of some of the different types of ladders to use for classroom demonstration purposes.* (Ref. A, pp. 436-442; Ref. B, pp. 85-87)

BACKGROUND INFORMATION

A stepladder is a portable ladder which opens out to look like a sawhorse, and which unlike other ladders is free standing.

A single portable ladder is a ladder of one section, commonly used in construction and other trades and occupations.

An extension ladder usually consists of two sliding sections which can be adjusted to different heights and locked in position.

A fixed ladder is one fastened more or less permanently to a structure. Rails of ladders fixed to top landings should extend at least 36 inches above the landing.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Ladder Safety Checks (2)	Obtain examples of various types of ladders which are in need of repair and ask students to identify the different defects that make the ladders unsafe. (Ref. A, pp. 436-442; Ref. B, pp. 85-87)	All ladders should be checked frequently for the following: • Loose steps or rungs • Slivers, cracks, breaks, or splits on wooden ladders • Loose fasteners, such as nails, screws, and bolts
• Checks for Stepladders (2)		In addition to the above checks, stepladders should be checked frequently for instability which usually occurs from abnormal stresses, loose or bent hinge spreaders, broken steps on hinge spreaders, and loose hinges.
• Checks for Extension Ladders (2)		In addition to the general ladder checks, extensions ladders should be checked for defective or broken locks which do not seat or lock properly when the ladder is extended.
• Checks for Fixed Ladders (2)		Because fixed ladders often receive fairly constant use, they should be checked especially carefully for general safety, and also to see that they are securely fastened.
• Protecting Wooden Ladders (2)		Wooden ladders should be coated with a transparent or opaque coating of shellac or linseed oil. They should not be painted, since the paint will cover structural defects which could endanger people who use the ladder.
Ladder Placement (3)	Explain with the use of diagrams how to determine mathematically where to place the base of a ladder in relation to the vertical plane of support. (Ref. A, pp. 436-442; Ref. B, pp. 85-87)	A major factor in safe ladder placement is stability. The following procedures should be used to achieve stability and safety in ladder placement: • Stepladders should be used fully opened on a solid even surface. The stepladder should not wobble or tip. • Single portable and extension ladders should be placed on a solid and even surface such that the base of the ladder is one-fourth of the ladder length from the vertical plane of the top support. Placing the base of a ladder too far from the vertical plane of support will put excessive stress on the ladder and may cause the base to slip away from the wall or vertical plane of support. Placing the base of a ladder too close to the vertical plane of support may cause the ladder to tip backward.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Ladder Placement (3) (cont'd)		• Doorways adjacent to or in front of portable ladders should be blocked, barricaded, or locked to protect both the people who might use the doorway and the person on the ladder. • Ladders should be placed so that there is at least 6 inches of clearance in back of the ladder and 30 inches of clearance in front of the ladder. • Ladders should not be placed against window frames or sashes, or against unstable supports such as loose boxes or barrels. A board should be fastened across the top of the ladder rails if the ladder is to be placed against a window. The board should be wide enough to rest evenly on the solid support on either side of the window. • Ladders should not be used in a high wind unless absolutely necessary. If such use is necessary, the ladder should be securely lashed in position. • Ladders should not be used in elevator shafts or hoistways unless the elevator or hoist is deactivated and the person on the ladder can be protected from falling objects. • Metal ladders should not be used around electricity.
dder Use)	List and demonstrate correct procedures for the use of ladders. Ask students to suggest reasons for each point presented. Have students tell about any accidents they know of that involved the use of ladders and indicate how these accidents could have been prevented. (Ref. A, pp. 436-442; Ref. B, pp. 85-87)	The procedures listed below should be followed by individuals using ladders: • Check to see that shoe soles are free from oil, grease, and mud. • Keep both hands free to hold the ladder while climbing. Use a rope to raise and lower tools and materials, if necessary. • When ascending and descending, always face the ladder. • Use a lifeline long enough to allow free movement, but short enough to prevent falls, fastened to a safety belt, if you must work above ground for extended periods. • Use a scaffold instead of a ladder for extensive off-ground work. • Never run up or down or slide down a ladder. • Never lean sideways while on a ladder. Move the ladder over instead. • Never use a ladder as a scaffold. It is not built for that type of use or stress. • Do not splice or tie short ladders together. • Do not leave ladders in position unattended unless they are secured at the top and the base.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Types of Characteristics of Scaffolding (5)	*The material presented here is basic. If additional information is needed, seek the assistance of an individual who is an expert on the topic. The material presented will be more meaningful to the students if they are able to visit a site where scaffolding is being used.* (Ref. A, pp. 442-448; Ref. B, pp. 77-85)	Scaffolds are temporary, elevated platforms, constructed to support workmen, tools, and materials for above-ground work. Wood scaffolds are rapidly being replaced by prefabricated steel bracket scaffolding. There are two basic types of scaffolds namely, swinging scaffolds which are supported on lines from above, and pole scaffolds which are supported from below.
• Swinging Scaffolds (5)		Swinging scaffolds are specially constructed platforms suspended from above on lines. They consist of flooring, toe boards, guard rails and a guard line, and outriggers.
• Pole Scaffolds (5)		Pole or supported scaffolds are made of either wood or metal framing. They are either built up as the work progresses, or the rolling type which is mounted on casters.
Uses of Scaffoled (6)	List and demonstrate correct procedures for the use of scaffolds. Ask students to suggest reasons for each point presented. Have students tell about any accidents they know of that involved the use of scaffolds and indicate how these accidents could have been prevented. (Ref. A, pp. 442-448; Ref. B, pp. 77-85)	The procedures listed below should be followed by individuals using scaffolds: • Inspect scaffolding daily before it is used. • Persons below scaffolding should wear protective clothing and equipment to prevent injury from objects falling off scaffolding. • If people must work underneath and adjacent to the scaffolding, their work area should be covered. • Scaffolding pieces which need repair should be marked as such and not stored with those pieces which do not need repair. • Scaffolds should not be used in high winds, or when covered with ice and snow. • Scaffolds should be kept clear of rubbish and unnecessary tools and materials. • Tools necessary but not in use should be kept in containers which are secured to the scaffolding. • Never throw or drop objects from a scaffold; lower them on a rope. • Never overload scaffolding.

UNIT 8

MODULE 9

MATERIALS HANDLING: LIFTING, CARRYING, AND PLACING MATERIALS

Explains how to lift, carry, and place materials safely.

OBJECTIVES

At the completion of this module students will be able to:

1 *State and demonstrate common principles of handling materials which help to prevent injuries*

2 *State and demonstrate correct procedures for lifting and setting down material*

3 *State and demonstrate correct procedures for carrying various objects or materials*

4 *State and demonstrate correct procedures for loading and operating a 2-wheeled hand truck*

5 *Identify, state, and demonstrate the use of various manual equipment for materials handling*

6 *State and demonstrate procedures for overturning and upending barrels and drums, with one or two men.*

7 *State and demonstrate correct procedures for operating a fork lift.*

REFERENCES

(A) National Safety Council. *Accident prevention manual for industrial operations;* 6th ed. Chicago, Ill. The Council. 1969.

(B) _____. *Supervisors safety manual;* 4th ed. Chicago, Ill. The Council. 1973.

CONTENT	INSTRUCTIONAL SUGGESTIONS
Principles of Handling Materials (1)	Explain and demonstrate the common principles of handling materials which help to prevent accidents. Arrange time so students may practice these skills under supervision.
• Inspection (1)	Devise situations that show unsafe work practices and have students identify the

BACKGROUND INFORMATION

Most injuries from materials handling involve hands and fingers. These injuries come from fingers being pinched or cut, knuckles or backs of the hands being skinned, or from slivers in fingers. Many of these injuries can be avoided by following correct procedures and precautions covered in this module.

Inspect material to be carried for slivers, sharp or jagged edges, burrs, or oily and slippery surfaces. Wipe off greasy or slippery surfaces, and wear gloves, especially if the other hazards to hands are present.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
• Hands (1) • Grip (1)	various unsafe practices and suggest corrective procedures. Make a clear distinction between the right and wrong procedures. If necessary, invite an expert on the topic to present the material to the students. Modify the material given to make it relevant to the occupational needs of the students. (Ref, A, pp. 504-505; Ref. B)	Keep hands free of oil, grease, or water if possible. Get a firm grip on the material to be carried. Do not place hands and fingers where they will be pinched or scraped, especially when setting the material down.
Procedures for Lifting and Setting Down Materials (2) • Lifting Materials (2) • Setting Down Materials (2)	Explain and demonstrate the procedures for lifting and setting down materials. Involve students in practical situations that will provide an opportunity to practice these skills under supervision. Devise situations that show wrong procedures and have students identify those wrong procedures and suggest corrective methods. Make a clear distinction between right and wrong procedures. If necessary, invite an expert on the topic to present the material to the students.	Training and correct lifting and setting down procedures are as important, or more important, than physical strength. When lifting materials, use the following procedures: • Look at the size, weight, and shape of the object to determine how to pick it up. • Place feet slightly and comfortably apart, with one foot slightly ahead of the other for good balance. • Crouch as close to the load as possible, keeping back straight by bending at the hips and not the middle of the back. Do not squat. • Grip the object securely. Do not change grip while carrying the object. Set the object down if you need to change your grip. • Straighten legs and bring back to a vertical position to lift the object. When setting down materials place the feet slightly apart and with one foot slightly ahead, bend legs and body from hips keeping back straight.

CONTENT	INSTRUCTIONAL SUGGESTIONS
• Setting Down Materials (2)	Modify the material given to make it relevant to the occupational needs of the students. (Ref. A, pp. 504-505; Ref. B.)
Procedures for Carrying Objects and Materials (3)	Explain and demonstrate the procedures for carrying objects and materials. Involve students in practical situations that will provide an opportunity to practice these skills under supervision.
• Changing Directions (3)	Devise situations that show wrong procedures and have students identify those wrong procedures and suggest corrective methods. Make a clear distinction between right and wrong procedures.
• Two People Carrying Objects (3)	
• Carrying Long Objects (3)	If necessary, invite an expert on the topic to present the material to the students.
	Modify the material given to make it relevant to the occupational needs of the students. (Ref. A, pp. 505-506; Ref. B)

BACKGROUND INFORMATION

When setting an object on a bench or table, place it on edge to avoid pinching hands or fingers and push it far enough onto the bench or table so it will not fall off. Slowly let the object down so its full weight rests on the surface of the bench. Position the object by pushing with hands and body from in front of the object.

When carrying objects and materials, use the following procedures:

- Carry only those loads which you can see around or over.
- Make sure that the route to be traveled is free from clutter and obstructions and that walking surfaces are not slippery.
- Carry loads in a comfortable position, and so that balance can be maintained.

When changing directions, the entire body should change direction simultaneously. Do not just twist the body.

When two people carry an object, one person should call the signals such as lift, and let it down.

Long objects should be carried with the front ends high enough to clear obstructions and other people's heads. The carrier should always check the surrounding area for clearance before he turns, and turn slowly to avoid building up turning momentum of the object. When two people carry a long object, they should place it on the same shoulders and keep in step.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Procedures for Loading and Operating a 2-Wheeled Handtruck (4)	Explain and demonstrate the procedures for loading and operating a 2-wheeled handtruck. Involve students in practical situations that will provide an opportunity to practice these skills under supervision. Devise situations that show wrong procedures and have students identify those wrong procedures and suggest corrective methods. Make a clear distinction between right and wrong procedures. If necessary, invite an expert on the topic to present the material to the students. Modify the material given to make it relevant to the occupational needs of the students. (Ref. A, pp. 512-513; Ref. B)	When loading a 2-wheeled handtruck place heavy objects below light ones to keep the center of gravity low. Place the load so it will not slip, shift, or fall and so that the operator will have an unobstructed view. When using a 2-wheeled handtruck, the operator should have only to push and balance the truck. The axle, not the handles, should support the load. The operator should operate the handtruck in such a manner that the truck will not run him over or fall on him. Never walk backwards with a hand truck. Pull the truck up an incline or ramp and walk behind it going down. Never run with a handtruck. Keep the truck under control at all times.
Procedures for Using Manual Equipment to Handle Materials (5) • Hand Hooks (5)	Explain and demonstrate the procedures for using manual equipment to handle materials. Involve students in practical situations that will provide an opportunity to practice these skills under supervision.	Hand or packing hooks should be carried and used in such a way that they do not present an injury hazard to the user or others around him. If the user carries the hook in his belt, he should cover the point. Hooks should be kept sharp and inspected regularly.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
• Crowbars (5) • Rollers (5)	Devise situations that show wrong procedures and have students identify those wrong procedures and suggest corrective methods. Make a clear distinction between right and wrong procedures. If necessary, invite an expert on the topic to present the material to the students. Modify the material given to make it relevant to the occupational needs of the students. (Ref. A, pp. 509-511; Ref. B)	The primary hazard of using a crowbar is that it may slip and injure the user or other workers. This hazard can be reduced by keeping the crowbar sharp, keeping gloves or hands free of grease and oil, and working in a safe position to avoid falling or pinching hands if the crowbar does slip. The primary hazard from rollers is crashed fingers or toes. This can be avoided by keeping fingers and toes clear of the rollers and the load and by changing the direction of the rollers with a sledge hammer or bar instead of using the hands or feet.
Procedures for Handling Barrels (6)	Explain and demonstrate the procedures for overturning and upending barrels and drums. Involve students in practical situations that will provide these skills under supervision. These procedures are specialized and involve a high injury potential. It may be necessary to invite an expert on the topic to present the material to the students. Devise situations that show wrong procedures and have students identify those	

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
	wrong procedures and suggest corrective methods. Make a clear distinction between right and wrong procedures. Modify the materials given to make it relevant to the occupational needs of the students. (Ref. A, pp. 509-511; Ref. B)	
Procedures for Operating a Forklift (7)	Explain and demonstrate the procedures for operating a forklift. It will be necessary for this topic to use a location that has a forklift and a qualified operator. These procedures are specialized and involve a high injury potential. It may be necessary to invite an expert on the topic to present the information to the students. Modify the information given to make it relevant to the occupational needs of the students. This topic may be used as the basis for a review of the various procedures to use when handling different kinds of materials. (Ref. A, pp. 619-622; Ref. B)	

UNIT 8

MODULE 10

ROPES, KNOTS, CHAINS, AND SLINGS

Explains safe use and maintenance of ropes, knots, chains, and slings

OBJECTIVES

At the completion of this module students will be able to:

1 *Identify types and characteristics of fiber rope*

2 *Properly inspect rope and locate and identify defects*

3 *List proper practices for care of rope in use and storage*

4 *State the applications and demonstrate how to tie various types of knots*

5 *Identify characteristics of wire rope*

6 *Identify causes of wear and deterioration of wire rope*

7 *Identify signs of wear on wire rope*

8 *State safe maintenance procedures for maintaining and storing wire rope*

9 *Properly inspect chain and locate and identify any defects*

10 *List safe practices for use and storage of chains*

11 *State two principles which involve the strength of a rope or chain sling*

REFERENCES

(A) Day, C.L. *The art of knotting and splicing;* 3d rev. ed. New York, N.Y. Arco Press. 1970.

(B) National Safety Council. *Accident prevention manual for industrial operations;* 6th ed. Chicago, Ill. The Council. 1969.

(C) _____. *Supervisors safety manual;* 4th ed. Chicago, Ill. The Council. 1973.

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CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Characteristics and Types of Fiber Rope (1)	Obtain samples of different types of fiber rope and ask students to identify the various types and list the characteristics of each type. (Ref. B, pp. 636-637; Ref. C)	
• Manila (1)		Manila rope has the greatest breaking strength of rope made from natural fibers. When new, manila rope can be identified by its ivory or light yellow color and its considerable luster.
• Sisal and Hemp (1)		Sisal and hemp are two natural fibers commonly used to make rope. Sisal rope is about 80 percent as strong as manila rope. It is identified by its white to yellowish-white color and its lack of gloss compared to manila rope. Its fibers are stiff and tend to splinter, making sisal rope less comfortable to handle than manila rope. Hemp rope is only about 50 percent as strong as manila rope, but is more resistant than manila to atmospheric deterioration.
• Nylon (1)		Nylon rope, unlike manila, sisal, and hemp rope, is made from synthetic fibers. The breaking strength of nylon rope is about 2 1/2 times that of manila rope and it has about four times the working elasticity. It is highly resistant to abrasion, water, mildew, and rot. Because nylon rope is so elastic, a worker must exercise care in releasing nylon rope under tension. Ropes made from other synthetic materials, such as polyester, are about one half as elastic as nylon and are therefore easier to work with in some situations.
Inspection and Location of Defects in Fiber Rope (2)	Obtain samples of damaged and potentially unsafe rope and ask students to identify the various defects and give the probable cause and corrective procedures for each defect. (Ref. A, pp. 637-641; Ref. C)	Rope in service should usually be inspected every 30 days in ordinary use, and much more often if in critical use, such as on a scaffold. Rope is inspected by visually examining its surface, and then partially untwisting the rope in several places to check the condition of the inside fibers. Possible defects in internal and external fibers include powdered fiber between strands, wear, abrasion, broken or cut fibers, variation in size or roundness of the strands, discoloration, and rotting. The inner strands should be unspotted and bright. Any natural fiber rope which has been exposed to acid should be scrapped or used on noncritical operations, since acid damage is often

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
• Bend Angle (11)		difficult to detect. One quick test for chemical damage is to scratch the fibers with a fingernail. Weakened fibers will easily come apart. Natural fiber rope loaded to over 50 percent of its breaking strength will be permanently damaged. Synthetics loaded to over 65 percent may be damaged. Charts specifying rope tensile strength are available and should be used.
Use, and Storage of Fiber Rope (3)		When using rope follow the procedures listed below:
• Use (3)		• Keep rope clean and if possible do not drag it on the ground. Dirt and sand particles abrade the fibers. • Do not let rope kink or become knotted unless necessary. Kinking and knotting weaken the fibers. • Do not knot rope to join it together since this will decrease the strength of the rope by up to 50 percent. Instead, splice the rope or use a longer piece. • Do not bend the rope sharply over corners. Use pads. • Do not use wet ropes around electrical sources. • Do not let a wet rope freeze.
• Storage (3)		Rope should be stored clean and dry in a place where air can circulate freely around it. The storage area should be free from chemicals, fumes, moisture, sunlight, and rodents.
		Remember, a rope is only as strong as its weakest segment.
Tying and Using Different Types of Knots (4)	*The knots listed in this topic are all-purpose knots. Other knots used by students in their work should be included, possibly as a substitute for ones they are less likely to use. (Ref. A, pp. 50, 70, 98, 106)*	A good knot is self-tightening under stress, does not slip and is relatively easy to untie.
• Square Knot (4)		The square knot is primarily useful for tying up bundles or for tying two pieces of string or cord together when there is tension on both ends of the cord. An improperly tied square knot may result in a granny knot which is practically useless. A surgeon's knot is a variation of a square knot which is even less likely to become loose.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
• Half Hitches (4)	*Provide time for the students to become proficient at tying these knots especially if the safety of others depends on their ability to perform this task.*	Two half hitches are commonly used to tie a line to a ring or a post, and are sometimes used either alone or in combination with other knots to tie down tarps when covering material.
• Clove Hitch (4)		The clove hitch is an important basic knot used to tie lines to posts, hooks, and for innumerable other purposes.
• Bowline (4)		The bowline is a basic knot which forms a fixed loop at the end of a line. It does not decrease the breaking strength of rope as much as do some other knots, is easy to tie, and never slips or jams.
Characteristics of Wire Rope (5)	Obtain samples of different types of wire rope and ask students to identify the various types and list the characteristics of each type. (Ref. B, pp. 641-642)	Wire ropes differ in type of wire used; type of core; and size, number, and arrangement of wires and strands. Generally, the greater the number of wires in a strand and the greater the number of strands in the rope, the greater the flexibility of the rope.
Causes of Wear and Deterioration of Wire Rope (6)	Obtain samples of damaged and potentially unsafe wire rope and ask students to identify the various defects and give the probable causes and corrective procedures for each defect. (Ref. B, pp. 643-649; Ref. C)	
• Corrosion (6)		Corrosion is especially serious on the interior wires. It is indicated by pitting of the rope surface.
• Kinks (6)		Kinks can occur when wire rope is installed or used improperly as when loads are hoisted with slack in the rope. A kink permanently weakens the rope as does removing the kink.
• Fatigue (6)		Excessive bending from using the rope over sheaves and drums with a small radius can weaken it as can multiple-layer winding on a drum.
• Overloading (6)		Overloading can weaken a wire rope, especially if loads are accelerated and decelerated. Personnel using wire rope should know its load limit and not exceed it.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
• Mechanical Abuse (6)		Mechanical abuse such as dragging, pinching, and cutting wires can weaken a wire rope.
Signs of Wear (7)	Obtain samples of wire rope showing different types of wear or deterioration. Ask students to identify the different types of wear and deterioration and to give the probable causes and corrective procedures for each type. (Ref. A, pp. 644-645; 648)	Wire ropes are usually inspected periodically by a trained inspector. For his own protection the worker should be able to recognize some of the more obvious signs of wear of wire ropes such as: • Broken wires or strands • Dislocated wires or strands • Bird caging or excessive wire • Strand dislocation caused by sudden release of tension on a rope and its consequent rebound • Strand nicking or nicks in an individual strand
Using and Storing Wire Rope (8)		In addition to being inspected periodically, wire rope should be cleaned, dried, and lubricated regularly. Wire rope should be stored in racks, off the ground, in dry, well-ventilated surroundings.
Inspect and Locate Defects in Chains (9)	Obtain samples of damaged and potentially unsafe chains and ask students to identify the various defects and give the probable courses and corrective procedures for each defect. (Ref. A, pp. 655-656)	A chain should be visually inspected daily, link by link, by the personnel using the chain. Possible defects in chains include the following: • Bent links • Cracks, especially in welds or shoulders • Corrosion pits • Elongation caused by stretching • Nicks and gouges, especially those which are perpendicular to the force applied to the chain
Use and Storage of Chains (10)		When using chains follow the procedures listed below: • Never splice a chain with a bolt. • Never put a strain on a kinked chain. • Take up slack slowly so that each link seats properly. • Do not hammer a hook over a chain link. • Make sure that the load is properly set in the bowl of the hook. • Know the load limit of the chain and do not exceed it.

CONTENT	INSTRUCTIONAL SUGGESTIONS	BACKGROUND INFORMATION
Use and Storage of Chains (10)		Store chains in a dry, well-ventilated place. They should be stored in racks and not allowed to be on the ground for long periods of time.
Rope and Chain Slings (11)	Explain and illustrate how the angle between the sling leg and the horizontal affects the stress on each leg even though the load remains constant. (Ref. A, 650-654; Ref. B)	When the angle between the sling leg and the horizontal is decreased, the stress on each leg of the sling is increased even though the load remains constant. The two vertical sling legs on a load of 1,000 pounds each support 500 pounds. The two legs when placed at an angle of 15° on a 1,000 pound load each support 1,932 pounds even though the load is still only 1,000 pounds.
• Leg Angle (11)		
• Bend Angle (11)		A sling or line which is bent sharply around a lead loses much of its strength. As a general rule, the radius of bend for wire rope should not be less than 10 times the diameter of the rope.

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